



TErrestrial Trunked RAdio

TETRA - Direct Mode Operation

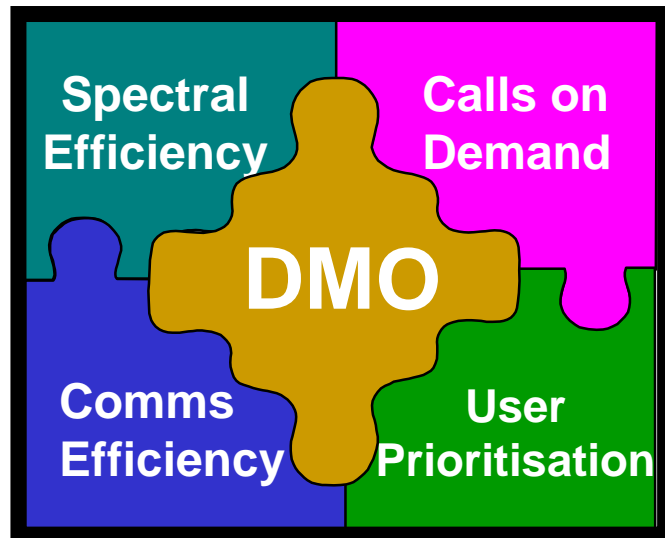
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Digital Systems
Motorola CGISS

**With thanks to Nick Smye at Mason Communications for the
use of some of his original material**



TErrestrial Trunked RAdio

The Trunking Benefits Jigsaw

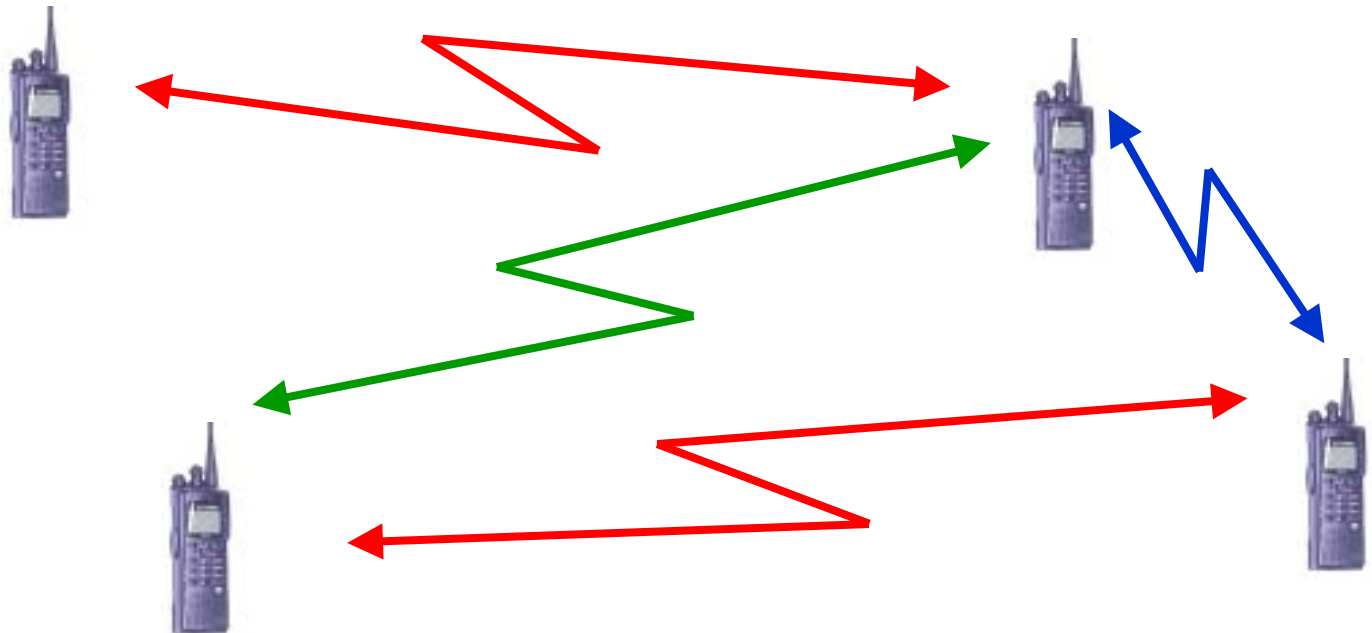


- Trunking offered many benefits over conventional communications and was a great success in the market
- It missed just one feature that conventional communications offered - direct terminal to terminal communication
- TETRA's multi-mode capability offers the **best of both worlds** !! Trunking and Direct Communications in a single terminal.



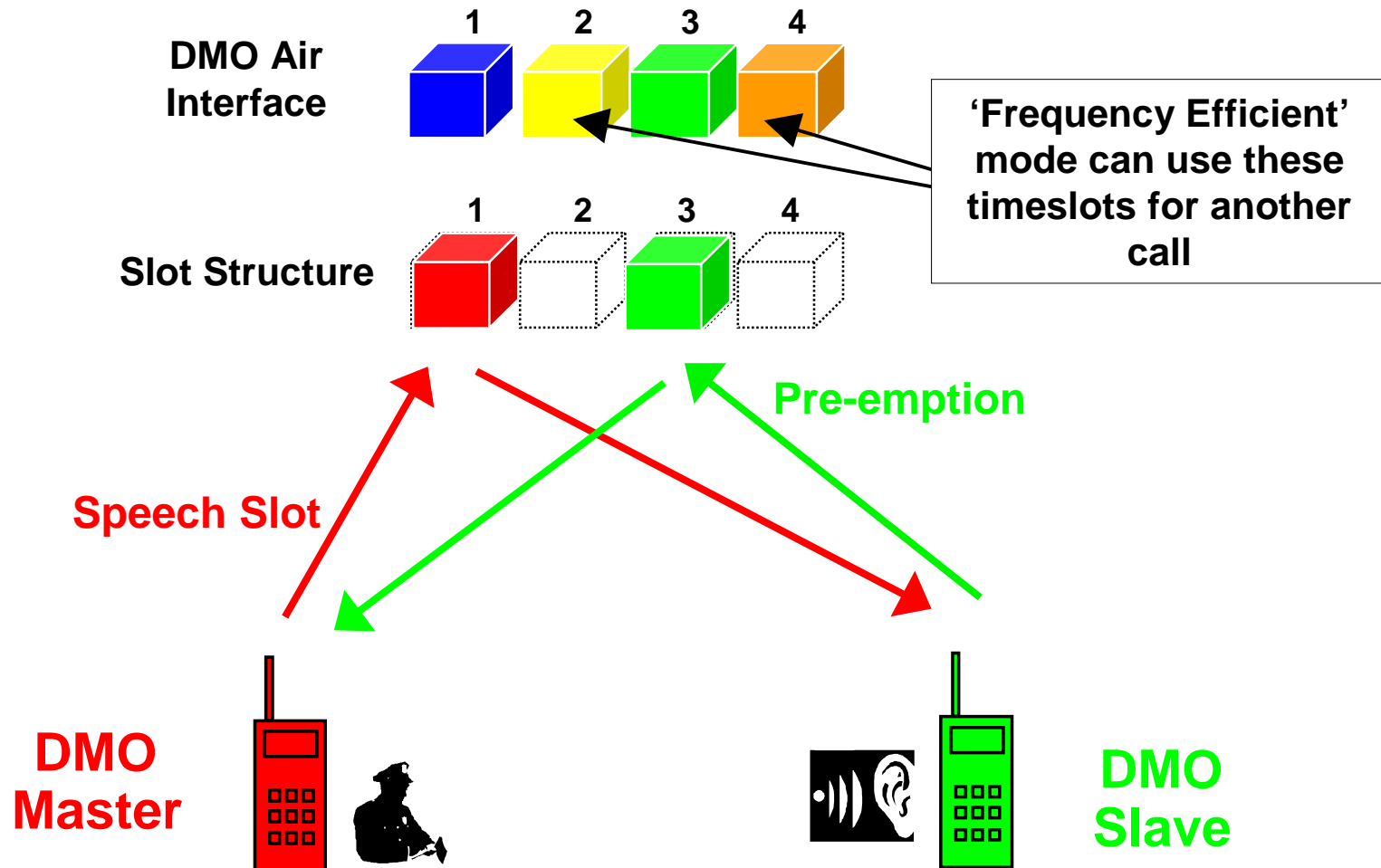
Direct Mode Operation (DMO)

- **Direct Mode (DM) is direct communication between two TETRA DM terminals.....**
...or several TETRA DM terminals or mobile stations without the use of a trunking network infrastructure.





'Back-to-Back' DMO





DMO Characteristics

- **Normal DMO enables 1 conversation per carrier (i.e. 1 per 4 timeslots)**
- **Transmitting radio acts as 'Master' on a single timeslot**
- **Receiving radio is 'Slave' on a single timeslot**
- **In normal mode, two time slots are used, two are free**
- **In Frequency Efficient Mode, all four timeslots are used (2x2) enabling two conversations per carrier**



Basic DMO Benefits

- **Operation outside the coverage of Trunking Infrastructure**
- **Gives extra capacity when trunked network is highly loaded**
- **Operations in poor signal strength areas**
- **Fall-back operation when the Trunking Infrastructure system is inoperative**
- **Covert Operations - cannot be monitored by Control**
- **'Stripline' applications (power, oil, water distribution lines) not requiring trunked network capacity**
- **Communication takes place on a *single* carrier**

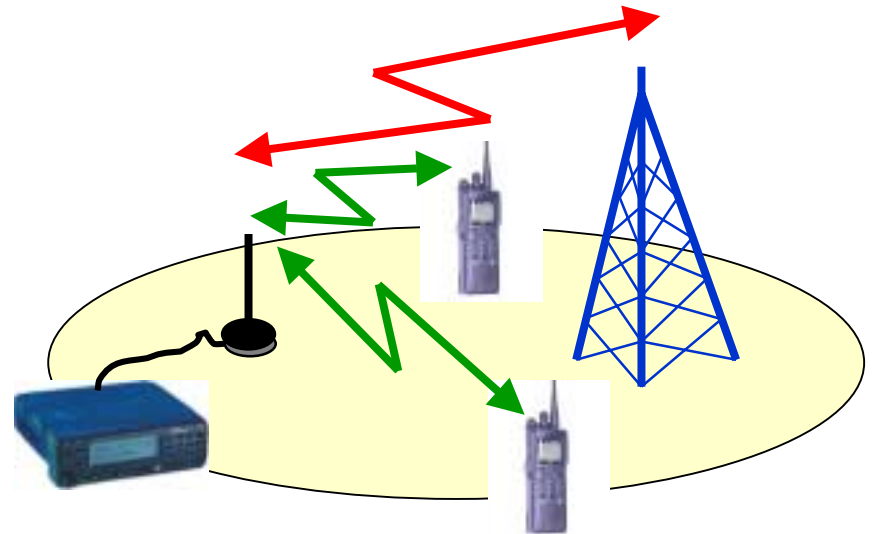
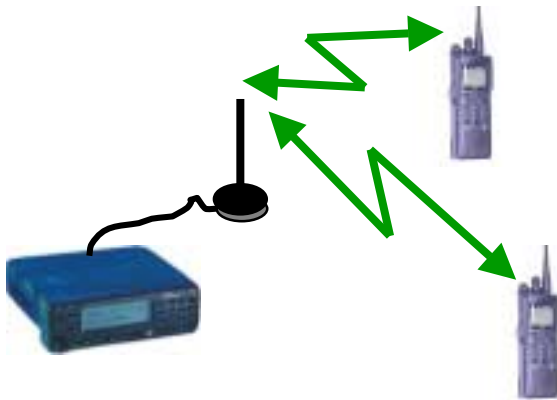


Key DMO Services

- **Group & Individual Voice Calls**
- **Emergency Calls**
- **Circuit Mode Data (up to 7.2kbps)**
- **Short Data Services (SDS)**
- **Status Messages**
- **Late Entry**
 - Just switched on
 - Switching from another DM channel
 - Returning to coverage area
 - Switching from Trunked Mode to DM
- **Encryption**
- **Over the Air Rekeying (OTAR)**

Other Direct Mode Opportunities

- **Direct Mode Repeaters**



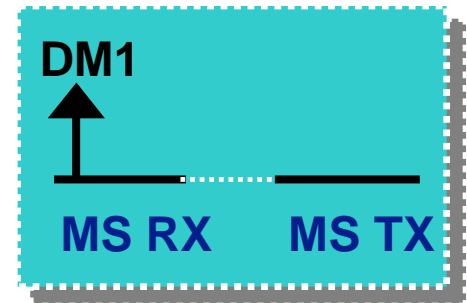
Mobile Unit **links** handheld DMO terminals.

Repeater operation can take place inside or outside the Base Station reception area.

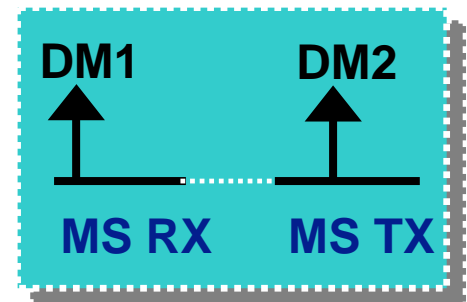
DMO Repeater

- Only one call per repeater
- Uses a 4 slot structure
 - 2 slot uplink
 - 2 slot downlink
 - Master/slave operation (3 slot delay)
- Single carrier (1A)
 - Simple RF
 - 1 conversation, 1 DM channel
 - Single carrier
- Dual carrier (1B)
 - More complex RF
 - 1 conversation, 2 DM channels
 - Supports multiple repeaters
 - **Reduces potential for RF interference**

TYPE 1A

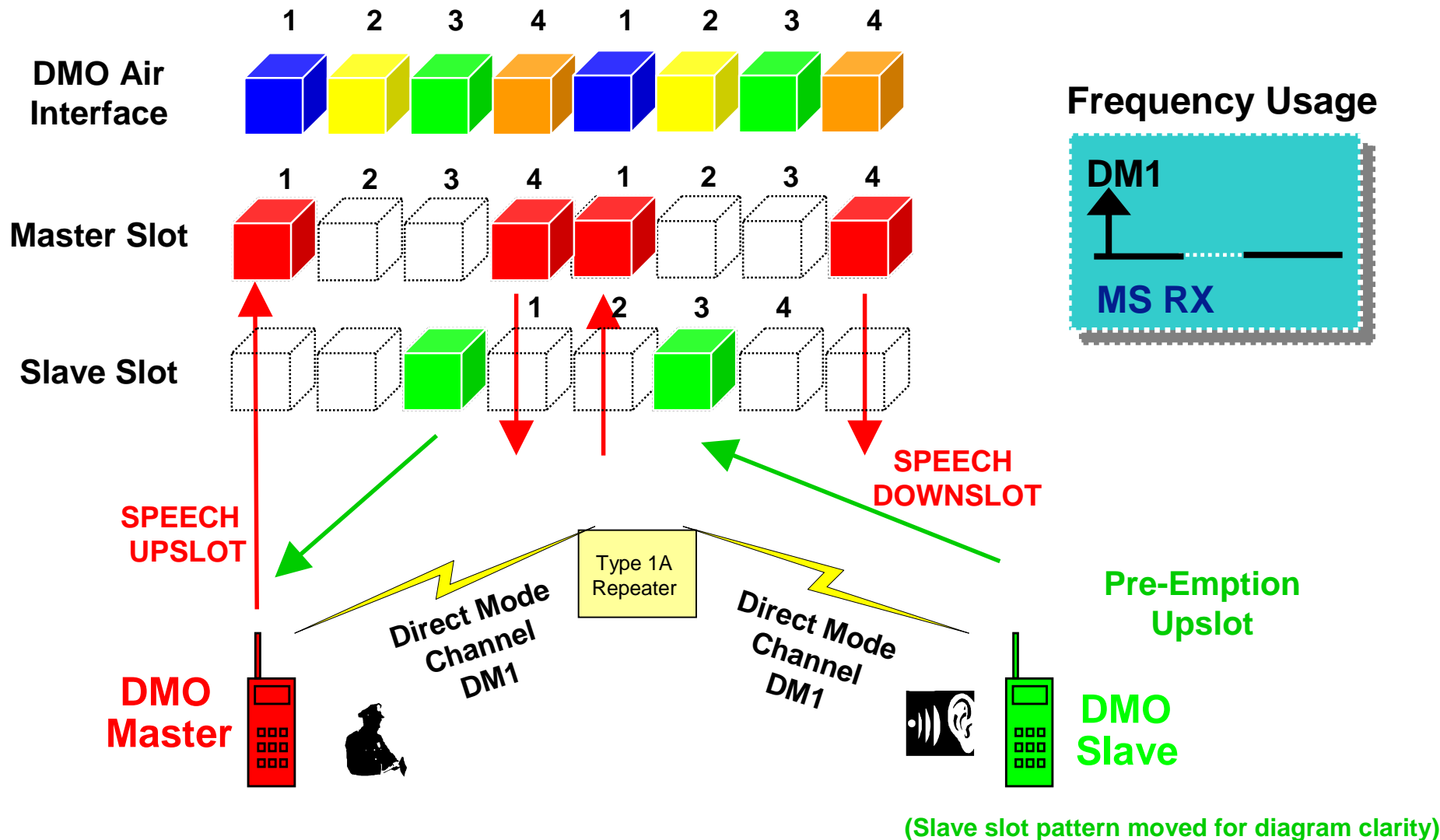


TYPE 1B



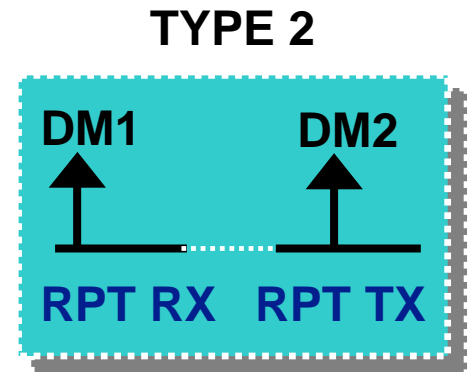


DMO Repeater Type 1A



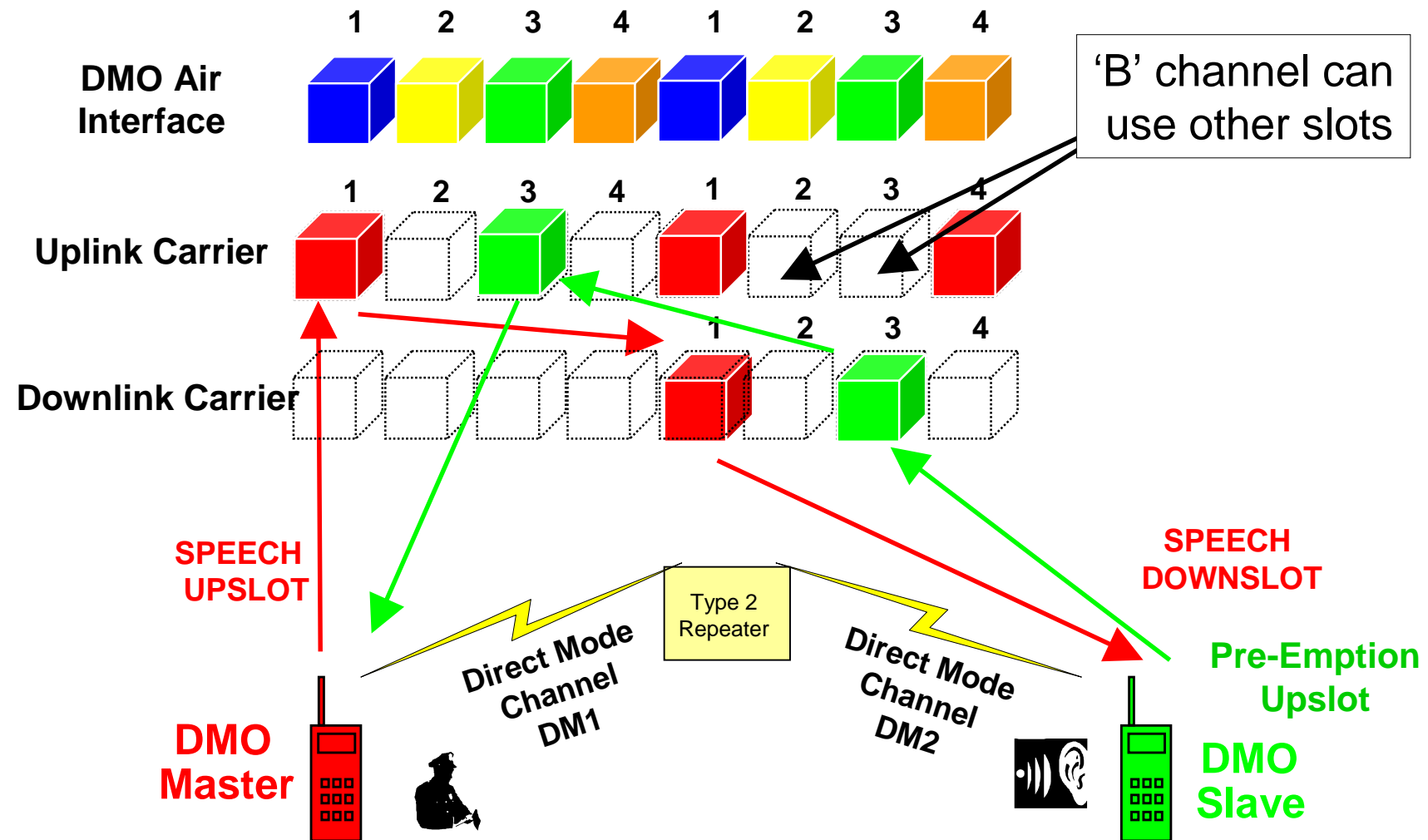
DMO Repeater Type 2

- Two simultaneous calls per repeater
- Uses a 4 slot structure
 - 4 slot uplink
 - 4 slot downlink
 - Master/slave operation (4 slot delay)
- Dual carrier
 - More complex RF but supports multiple repeaters
- Uses power control and addressing





DMO Repeater Type 2

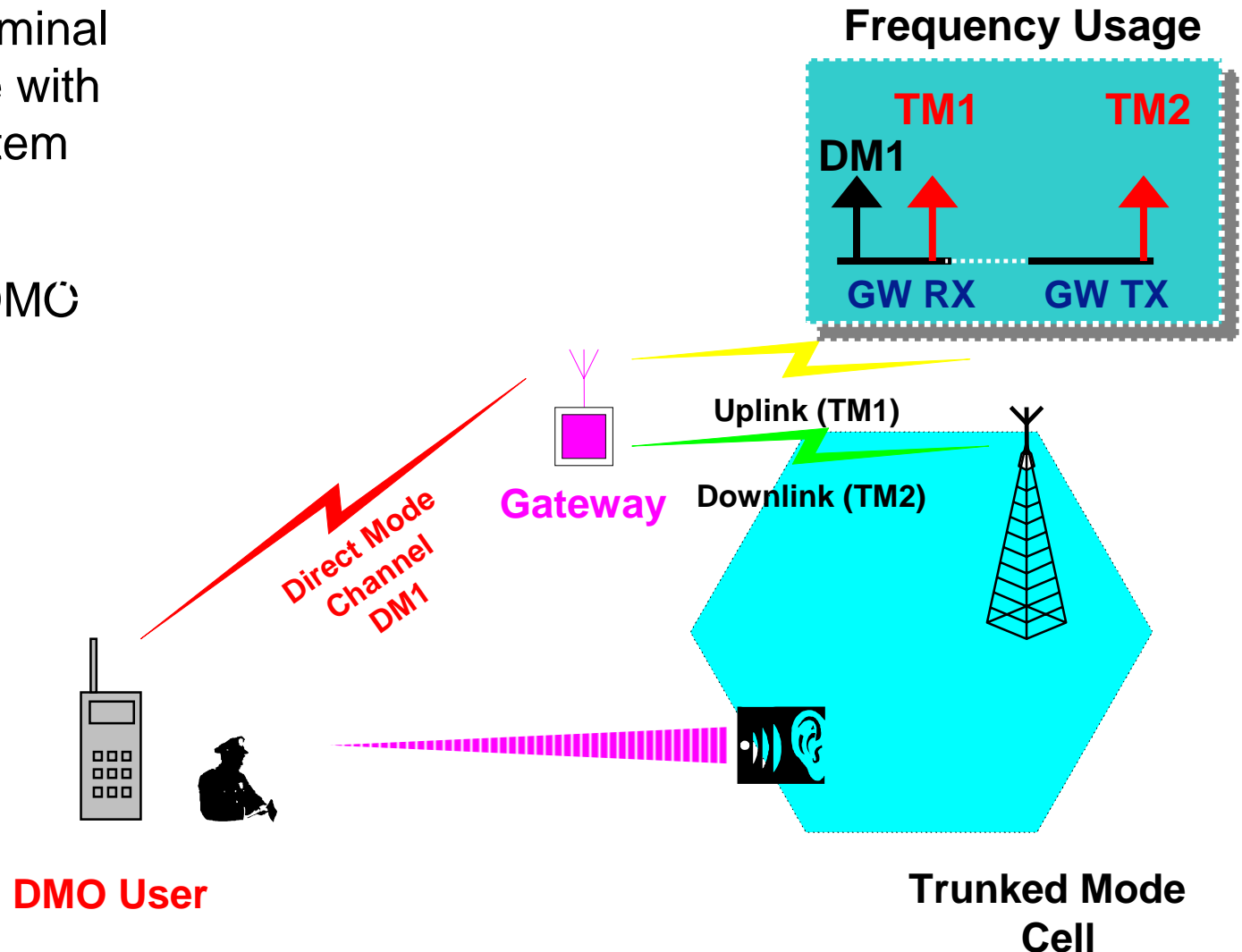


(Slave slot pattern omitted for diagram clarity)



Direct Mode Gateway

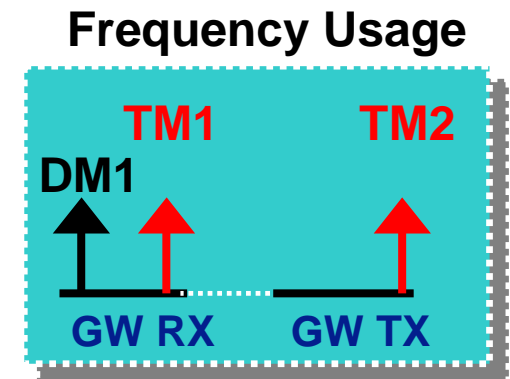
- Enables DM terminal to communicate with the trunked system & vice versa
- Uses 'normal' DMC air interface (single call)
- One DM carrier per call





Direct Mode Repeater Gateway

- Combines the functionality of a repeater and a gateway (similar to a VHF-UHF talk-through repeater)
- Interconnects direct mode to trunked mode
- Uses 'normal' DMO air interface (single call)
- One or Two DMO carriers per call (as per Type 1A or 1B)
- Can be manned or stand alone (i.e. free running or manned by an operator)





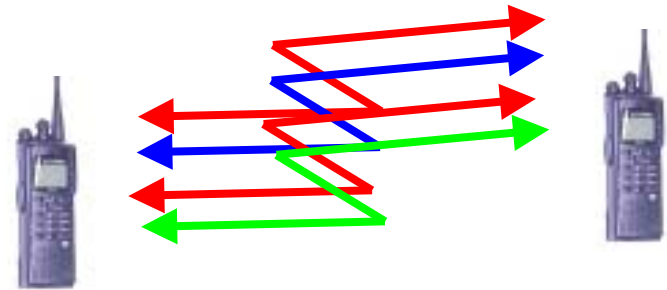
Direct Mode Gateway Operation Benefits

- **Extends range of Trunking Mode Operation**
- **Reduces Infrastructure costs**
- **Enables remote 'occasional users' to have communication at cost effective rates**
- **Gives Network Operators better coverage possibilities during early stages of network roll-out**



Managed Direct Mode Operation (MDMO)

- **Normally no restriction on transmitting in Direct Mode (provided that the channel is free)**
- **Removes potential for interference from roaming DMO terminals in non-harmonised spectrum**



MDMO Authorisation Signal

- MDMO terminal restricted from transmitting unless it receives an **authorising signal**



- Facility made available **ONLY** on areas which are free from interference
- Validity time encoded in authorising signal
- Generated by authorising device which is in permanent contact with system, or.....
- generated by modified DMO Gateway or Repeater/Gateway device

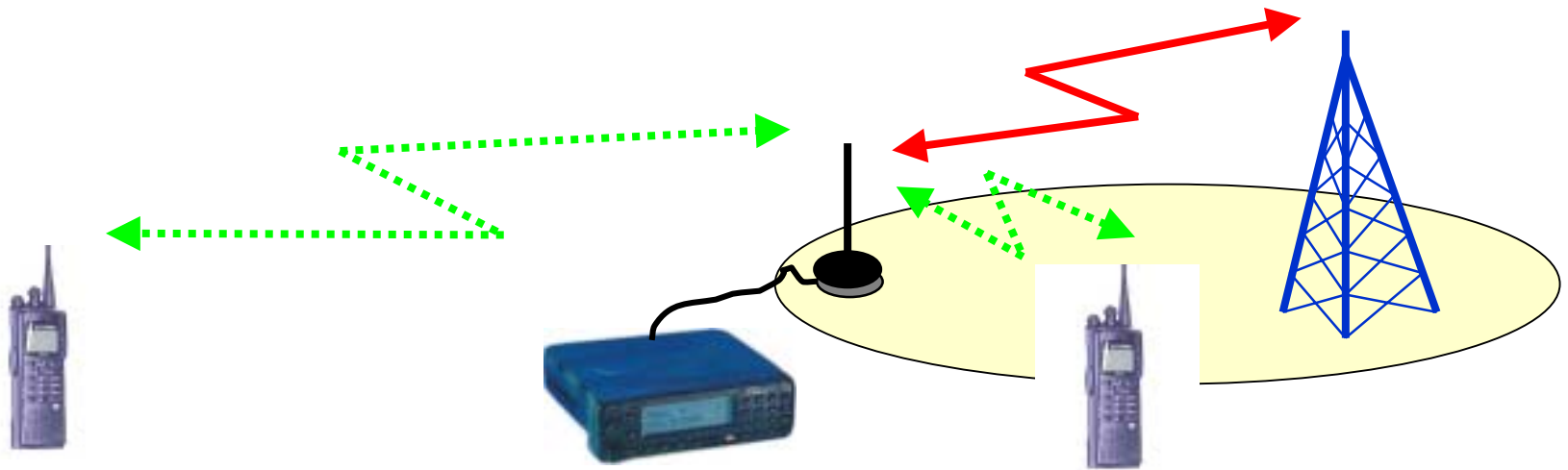


Benefits of MDMO

- **Network Operators maintain better control of their network resource/revenues**
- **Removes potential for interference**
- **Manages roaming**

Dual Watch

- Radio is operational in one system mode (Direct or Trunked) and simultaneously monitors signalling on the other system.



Mobile Unit whilst engaged in a call in **Trunked** mode is alerted of a **DMO** call/request from a **DMO** terminal.